

REMARKS

Claim Rejection 35 U.S.C. § 112

The Examiner has rejected claim 31 under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claims the subject matter which Applicant regards as the invention. Applicant has amended claim 31 to more particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant, therefore, respectfully requests the removal of the 35 U.S.C. § 112, second paragraph, rejections of claim 31.

Claim Rejections - 35 U.S.C. § 103

The Examiner has rejected claim 31 under 35 U.S.C. § 103(a) as being unpatentable over Schutz (US Patent 6,136,714) or Jeong (US Patent 5,960,317) in view of Avanzino et al. (US Patent 6,140,239).

It is the Examiner's position that Schutz and Jeong teaches that a dielectric layer may be formed over a substrate. The dielectric layer may have trenches therein. A barrier may be formed in the trenches and on a top surface of the dielectric layer. Metal may be deposited over the barrier. The metal and barrier may be polished with a slurry. A slurry includes an abrasive. The barrier may be polished from the top surface of the hard dielectric layer with the slurry until the barrier is removed from the top surface of the hard dielectric layer with the slurry until the barrier is removed from the top surface of the hard dielectric layer (Col. 2, lines 26-33 of Schutz; col. 4, lines 6-35 of Jeong).

It is the Examiner's position that Schutz or Jeong does not teach that the slurry may include an abrasive harder than the metal and less harder than the barrier. It is the Examiner's position, however, that Avanzino (Col. 4, lines 10-11) teaches that the abrasives may comprise iron oxide for the metal polishing so as to smooth surface finish without any significant abrasion (Col. 4, lines 30-33). Hence, it is the Examiner's position that it would have been obvious to one with ordinary skill

in the art to use iron oxide of Avanzino in the process of Schutz or Jeong in order to smooth surface finish without any significant abrasion.

It is Applicant's understanding that the cited fail to teach or render obvious Applicant's invention as claimed in claim 31. In claim 31, Applicant claims a method of forming an interconnect wherein a barrier layer is formed over and into trenches formed on a dielectric layer. A metal layer is then deposited over the barrier layer. The metal layer is then polished with a slurry that includes an abrasive which is harder than the metal and less hard than the barrier layer and less hard than the interlayer dielectric. After removing the metal layer by polishing and exposing the barrier layer on the top surface of the dielectric, the barrier layer on the top surface of the dielectric is polished utilizing the same slurry used to polish the metal layer. By utilizing a slurry that has an abrasive that is harder than the metal layer but less hard than the barrier layer and less hard than the interlayer dielectric, then the same slurry can be utilized to remove the barrier from the dielectric layer as used to remove the metal layer from the barrier layer. Accordingly, in Applicant's claimed invention, by utilizing a slurry having an abrasive which is harder than the metla film but less than the barrier layer and the dielectric layer, Applicant is able to remove the barrier layer from the top surface of the dielectric layer utilizing the same slurry as used to remove the metal film formed over the barrier layer.

It is Applicant's understanding that the combination of either Jeong and Avanzino or Schutz and Avanzino fail to teach or render obvious Applicant's invention of utilizing a slurry having an abrasives, which is harder than the metal to be polished but yet which is less hard than the barrier layer and interlayer dielectric, to remove the metal film over the barrier layer as well as to remove the barrier layer over the dielectric. It is Applicant's understanding that Jeong et al. discloses a polishing process in which a first polishing step and slurry is used to remove metal layer 35 and barrier layer 33 (Figure 2C and Figure 2D) from an insulating layer 31 and then a second polishing step and slurry are used to planarize the insulating layer 31a. Similarly, Schutz et al. describes a polishing process in which a metal layer 16 and a barrier layer 14 are removed from an insulating layer 12 utilizing a single slurry. Contrary to the Examiner's position, however, one of ordinary skill in the art would not utilize the iron oxide slurry of Avanzino in the process of Jeong or

Schutz to remove both the metal layer and underlying diffusion barrier layer because Avanzino specifically teaches to utilize two different slurries; one for removing copper layer 20 from barrier layer 14 and a second for removing barrier layer 14 from the interlayer dielectric.

That is, it is Applicant's understanding that Avanzino teaches to utilize two different CMP processes. The first CMP process is utilized to remove copper layer 20 from barrier layer 14 (Col 5, lines 34-47). The first CMP process stops on barrier layer 14 as shown in Figure 3 (Col. 5, lines 44-45). After the first CMP process, the substrate is cleaned of residual iron particles with a dilute organic acid (Col. 5, lines 39-43). After stopping on barrier layer 14 and cleaning the substrate of residual iron oxides, a second CMP process is used to remove barrier layer 14 form the upper surface of the interlayer dielectric 10 leaving a planarized surface as shown in Figure 4 (Col. 5, lines 44-47). As such, Avanzino clearly fails to teach removing the barrier layer 14 with the same slurry as utilized to remove copper layer 20. Additionally, it is to be noted that one of ordinary skill in the art would not be motivated to utilize the slurry containing iron oxide used to polish copper layer 20 to polish barrier layer 14 because Avanzino specifically teaches to clean the substrate to remove residual iron oxide (i.e., removing remaining portions of the first slurry) prior to polishing the barrier layer. If Avanzino envisioned or contemplated utilizing his slurry containing iron oxide to polish barrier layer 14, he certainly would not have suggested or taught to remove residual iron oxide prior to polishing barrier layer as he has done. Accordingly, one of ordinary skill in the art would not utilize the iron oxide slurry taught in Avanzino to remove both the metal layer and underlying diffusion layer in the process of either Jeong or Schutz.

For the above mentioned reasons, it is Applicant's understanding that the cited references clearly fail to teach or render obvious Applicant's invention as claimed in claim 31. Applicant, therefore, respectfully, requests the removal of the 35 U.S.C. § 103 rejections of claim 31 and seeks an early allowance of this claim.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

31. (Amended) A method of forming an interconnect comprising:
 forming a [hard] dielectric layer over a substrate, the dielectric having
 trenches therein;
 forming a barrier in the trenches and on top of the surface of the [hard]
 dielectric layer;
 depositing metal over the barrier;
 polishing the metal with a slurry that includes an abrasive harder than the
 metal and less hard than the barrier and less hard than said dielectric layer; and
 polishing said barrier from the top surface of said [hard] dielectric layer with
 said slurry until said barrier is removed from the top surface of said [hard] dielectric
 layer.

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